Spixiana	3	1	53-57	München, 1. März 1980	ISSN 0341-8391

Fine Structure of the Larval Eye of Lepidochitona cinerea L.

(Mollusca, Polyplacophora)

by **Franz Peter Fischer***

Zoologisches Institut der Universität München

Abstract

The larval eye of the polyplacophoran *Lepidochitona cinerea* L. consists of a cup of pigment cells and a few visual cells. These have microvilli and one or two cilia at their apical end; they are rhabdomeric photoreceptors. Their fine structure is different from the visual cells in the aesthetes and shell eyes of adult chitons.

Introduction

The morphology of the photoreceptors of adult polyplacophorans has been studied extensively in the last few years. The aesthetes, small organs which penetrate the upper shell layer in large numbers, possess among various other cell types also photoreceptor cells (Haas & Kriesten 1978, Fischer 1978, 1979, Fischer & Renner 1978). In several species some of the aesthetes have become eyes of varying complexity (Boyle 1969, Haas & Kriesten 1978).

In contrast to the adults the trochophora larvae have two ocelli behind the prototroch (Kowalevsky 1883, Heath 1904). They persist invariably for a certain period after the metamorphosis. After their degeneration the aesthetes and – where present – the shell eyes are the only known photoreceptors in the polyplacophorans.

Material and method

Newly settled young *Lepidochitona cinerea* L. from Oosterschelde/Netherlands were fixed for two hours in 3% glutaraldehyde (0,1 M cacodylate buffer, pH 7,4) followed by 2% OsO_4 and embedded in Epon.

The ultrathin sections (diamond knife) were stained with uranylacetate and lead-citrate, and examined with a Zeiss 9 S-2 electron microscope.

* I wish to thank Prof. W. Haas, Bonn, for the fixed and embedded specimens of *Lepidochitona cinerea*.

Results

The larval ocelli lie below the lateral nerve cord. Their openings are directed to the lateral side (Fig. 1). The adjacent epidermis is not especially modified.

A larval eye consists of about nine pigment cells forming a cup around a rhabdome. The perikara of the two or three visual cells are situated at the proximal side of the ocellus somewhat under the pigment cells. The diameter of an ocellus is around 15 µm, the pigmental cup is ca. 8 µm wide.

The pigment cells

A pigmental layer of about 3 µm surrounds the rhabdome. It consists of round membrane-bound granules (0,6 µm) in the apical part of the pigment cells (Fig. 2). Towards the rhabdome a few microvilli are present. The pigment cells are bound to one another by desmosomes along the luminal border.

In the more proximal part of the cell numerous larger, far less electron-dense granules (1–4 µm) fill the cytoplasm around the nucleus. Their content is fairly uniform, each is surrounded by a membrane. These structures are also found in many other tissues of young chitons. The pigment cells contain relatively many mitochondria but not much gER.

The visual cells

Each visual cell consists of the perikaryum at the proximal side of the ocellus and the distal part which penetrates the pigmental layer forming a rhabdomere at the apical end.

The large nucleus contains very little condensed chromatin. Nearby we find a system of folded membranes (Fig. 3); between them are groups of small granules. The cytoplasm around the nucleus is full of mitochondria; more distally one or two golgi complexes are present. They produce small (<0,1 µm) clear vesicles which characterize the distal part of the cell as do the many microtubules running lengthwise. Near the nucleus several multivesicular bodies are a common feature. Some gER is also present.

The rhabdome

From the apical pole of each visual cell (Fig. 4) arise numerous microvilli and one or two cilia (9+2 type, with basal body and root). The ciliary membrane is somewhat irregular and has a few short microvillilike projections. The 9+2 structure is not altered at any point. The densely packed microvilli (0,1 µm) derive from the whole distal part of the visual cell. In some areas a few microvilli flatten and form a system of parallel membranes (Fig. 5; begin of microvilli breakdown).

Fig. 1: Semithin section through a young *Lepidochitona cinerea*. Arrows: larval ocelli. Scale mark: 25 µm

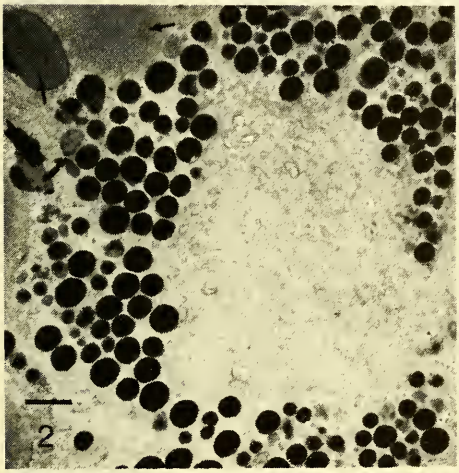
Fig. 2: Pigmental cup around the rhabdome. Arrows: proximal granules in the pigment cells (no pigment function). Scale mark: 1 µm

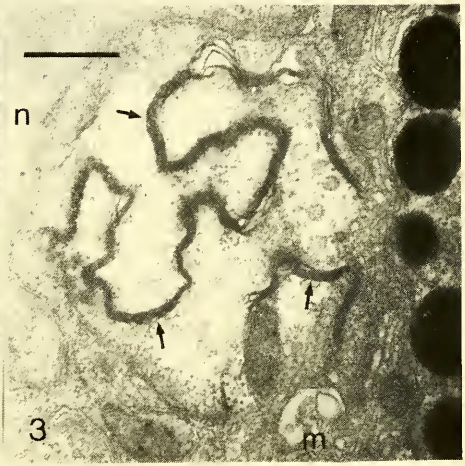
Fig. 3: Visual cell. n nucleus, m multivesicular body, arrows: membraneous system. On the right: pigment of a pigment cell. Scale mark: 1 µm

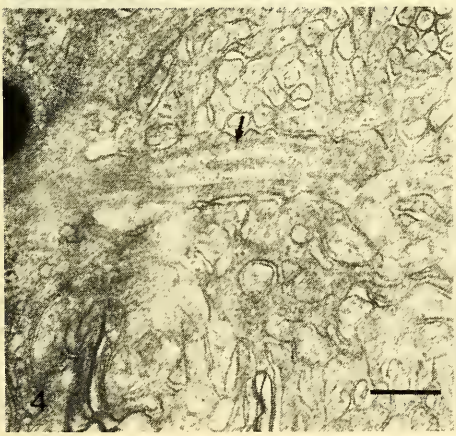
Fig. 4: Rhabdome. From a visual cell originate cilia (arrow) and numerous microvilli. Scale mark: 0,2 µm

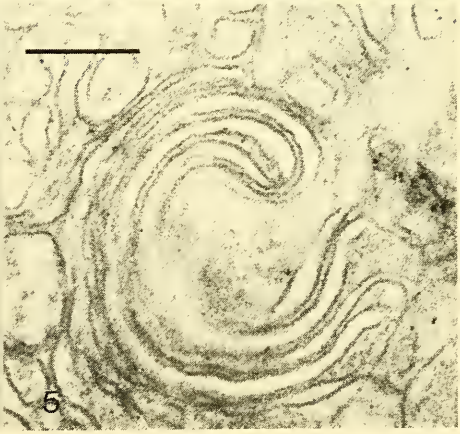
Fig. 5: Begin of microvilli breakdown. Scale mark: 0,25 µm


1


2


n
3
m


4


5

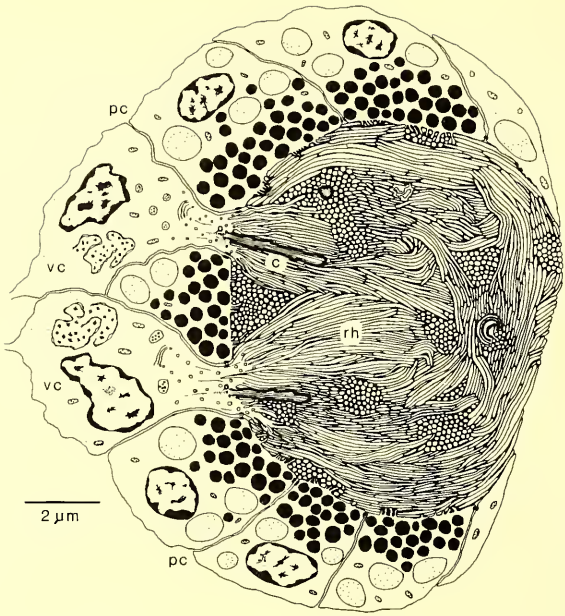


Fig. 6: Schematic diagram of the larval eye. vc visual cell, pc pigment cell, c cilium, rh rhabdome

Discussion

The larval eye of *Lepidochitona cinerea* L. is of the everse type and resembles primitive ocelli of other invertebrates (e. G. Vaupel-von Harnack 1963). The visual cells are rhabdomeric photoreceptors comparable with those of a holothurian (Yamamoto & Yoshida 1978) and seastars (Eakin & Brandenburger 1979). The presumed photoreceptor organelles (the microvilli) are not morphologically connected with the cilia. There may however remain some doubt whether or not there is any point in distinguishing between the two photoreceptor types (rhabdomeric and ciliary, Eakin 1963) in such relatively simple visual cells.

A comparison of the larval eyes with the visual cells of the aesthetes (Fischer 1978, 1979) and the shell eyes (Boyle 1969, Haas & Kriesten 1978) shows marked differences apart from the common feature of a photoreceptor cell (active nucleus, many mitochondria, multivesicular bodies, numerous vesicles, microtubules). The larval ocelli don't exhibit the densely packed membraneous structures of a specialised agranular ER which is characteristic for the photoreceptor cells of adult chitons. These produce the small vesicles which are probably involved in the photopigment transport (see Eakin & Brandenburger 1967, 1978); in the larval visual cells they derive from the Golgiapparatus. There seems to be no relation between the larval eye and the photoreceptors of the adult polyplacophorans.

Literature

BOYLE, P. 1969: Fine structure of the eyes of *Onithochiton neglectus*. – Z. Zellforsch. **102**: 313–332

EAKIN, R. M. 1963: Lines of evolution of photoreceptors. In: General physiology of cell specialisation. – New York.

— — & BRANDENBURGER, J. L. 1967: Functional significance of small vesicles in photoreceptor cells of a snail, *Helix aspera*. – J. Cell Biol. **35**: 36A

— — & BRANDENBURGER, J. L. 1978: Autofluorescence in the retina of a snail, *Helix aspera*. – Vision research **18**: 1541–1543

— — & BRANDENBURGER, J. L. 1979: Effects of Light on Ocellí of Seastars. – Zoomorphol. **92**: 191–200

FISCHER, F. P. 1978: Photoreceptor cells in chiton aesthetes. – Spixiana **1**: 209–213

— — 1979: Die Ästheten von *Acanthochiton fascicularis*. – Zoomorphol. **92**: 95–106

— — & RENNER, M. 1978: Die Feinstruktur der Ästheten von *Chiton olivaceus*. – Helgol. wiss. Meeresuntersuchungen **31**: 439–457

HAAS, W. & KRIESTEN, K. 1978: Die Ästheten mit intrapigmentärem Schalenauge von *Chiton marmoratus* L. – Zoomorphol. **90**: 253–268

HEATH, H. 1904: The larval eye of chitons. – Proc. Acad. nat. Sci. Philad. **56**: 257–260

KOWALEVSKY 1883: Embryogénie du *Chiton polii* (Philippi) avec quelques remarques sur le développment des autres Chitons. – Ann. Mus. hist. nat. Marseille T 1, No. 5

VAUPEL-VON HARNACK, M. 1963: Über den Feinbau des Nervensystems des Seesternes (*Asterias rubens* L.). III Mitteilungen: Die Struktur der Augenpolster. – Z. Zellforsch. **60**: 432–451

YAMAMOTO, M. & YOSHIDA, M. 1978: Fine structure of the ocelli of a synaptic holothurian, *Opheodesoma spectabilis*, and the effects of light and darkness. – Zoomorphol. **90**: 1–17

Adress of the author:
Dr. F.-P. Fischer, Zoologisches Institut der Universität
Luisenstr. 14, D-8000 München 2

Angenommen am 28.8.1979